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Research Note

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE

INTERMOUNTAIN FOREST & RANGE EXPERIMENT STATION
OGDEN UTAH

No. 100 (Revised) October 1962

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SPECIFIC GRAVITY OF LODGEPOLE PINE IN THE INTERMOUNTAIN REGION

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ABSTRACT

Specific gravity at breast height, calculated by the increment core method, gives a satisfactory estimate of average tree specific gravity. The relation of tree specific gravity to core specific gravity at breast height is expressed by:

$$Y = 0.661X + 0.143$$

where Y = tree specific gravity
X = specific gravity at breast height

Also, r = 0.754, and SE = 0.021

Specific gravity decreases noticeably from stump height up to 20 feet, but changes little above that.

Specific gravity or density is a basic property used in general estimates of wood quality and in converting timber volume estimates to a weight basis. The increment core technique described by Mitchell[2/] and by Wahlgren and Fassnacht[3/] can be used to estimate the specific gravity of standing trees. This paper presents results of a study of use of this increment core technique in estimating specific gravity for lodgepole pine.

This study, started in July 1960, used 44 dominant trees from five locations on four National Forests in Idaho, Utah, and Wyoming (table 1). After they were felled, cross sections were cut at stump height, breast height, and at 8-foot intervals. Increment cores to the pith of each tree were extracted at breast height. Specific gravity for both cores and cross sections was determined on the bases of green volume and ovendry weight. Wood density in pounds per cubic foot was computed for each tree. Results are shown in tables 2 and 3.

Differences in average specific gravity at breast height calculated by two methods (increment core and stem section) and average tree specific gravity estimated by the stem section method are nonsignificant. Therefore, specific gravity at breast height calculated by the core method gave a satisfactory estimate of average tree specific gravity.

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2/ Mitchell, H. L. Wood quality evaluation from increment cores. Jour. Tech. Assoc. Pulp and Paper Indus. 41: 150-156. 1958.

3/ Wahlgren, Harold E., and Donald L. Fassnacht. Estimating tree specific gravity from a single increment core. U.S. Forest Serv. Forest Prod. Lab. Rpt. 2146, 9 pp., illus. 1959.

Table 1.--Location, elevation, and age class of stands sampled

Area	National Forest and State	Elevation	Stand age class
		Feet	Years
Bishop Burn	Targhee (Idaho)	6,500	41-50
Moose Creek Plateau	Targhee (Idaho)	8,000	81-90
Bostetter Station	Sawtooth (Idaho)	7,500	51-60
Sheep Creek Park	Ashley (Utah)	8,400	71-80
Horse Creek	Bridger (Wyoming)	7,900	21-30

Table 2.--Specific gravity of lodgepole pine at breast height calculated by the increment core and stem section methods, and average tree specific gravity by the stem section method

Area	Trees	Diameter range (d.b.h.)	Core b.h. specific gravity: Mean	Core b.h. specific gravity: 95-percent confidence limits	Section b.h. specific gravity: Mean	Section b.h. specific gravity: 95-percent confidence limits	Tree specific gravity: Mean	Tree specific gravity: 95-percent confidence limits	Density: Mean	Density: 95-percent confidence limits
	Number	Inches							Pounds per cu. ft.	
Bishop Burn	10	3.5- 6.3	0.394	±0.029	0.406	±0.078	0.388	±0.049	24.2	±2.7
Moose Creek Plateau	9	5.2-11.8	.416	± .072	.428	± .068	.414	± .079	25.8	±4.9
Bostetter Station	5	5.3- 8.1	.356	± .030	.367	± .048	.375	± .042	23.4	±2.6
Sheep Creek Park	10	4.1- 8.5	.399	± .055	.402	± .140	.415	± .044	25.9	±2.8
Horse Creek	10	2.2- 5.1	.352	± .035	.365	± .068	.352	± .062	22.7	±3.8
All	44	2.2-11.8	.386	± .067	.396	± .078	.392	± .068	24.5	±4.2

The average specific gravity for lodgepole pines at breast height estimated by the increment core method in this study (0.386), agrees closely with that given for the species (0.38) in the Wood Handbook.[4/] According to this handbook, lodgepole and ponderosa pine have approximately the same specific gravity. However, the value for trees in this study is slightly less than that found by Conway and Minor[5/] for ponderosa pine in Arizona by the same method (0.404).

Variations in specific gravity within the sample trees were also studied. Specific gravities of the disk cross sections taken at successive heights were plotted for the 44 trees. Figure 1 shows the usual exponential curve for this relationship. Although specific gravity decreases from stump height up to 20 feet, little change occurs above that; the same relation was found for ponderosa pine in Arizona.[6/]

4/ U.S. Forest Service. Wood handbook. U.S. Dept. Agriculture, Agr. Handb. 72, 528 pp., illus. 1955. P. 76.

5/ Conway, Errett M., and Charles O. Minor. Specifc gravity of Arizona ponderosa pine pulpwood. U.S. Forest Serv. Rocky Mountain Forest and Range Expt. Sta. Res. Note 54, 3 pp., illus. 1961.

6/ Ibid.

Table 3.--Minimum and maximum specific gravity of sample trees by area and basis of determination

Area	Core b.h. specific gravity		Section b.h. specific gravity		Tree Specific gravity	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
Bishop Burn	0.379	0.417	0.357	0.486	0.329	0.414
Moose Creek Plateau	.377	.482	.378	.465	.366	.487
Bostetter Station	.342	.370	.342	.393	.350	.393
Sheep Creek Park	.353	.437	.358	.429	.391	.456
Horse Creek	.315	.380	.331	.447	.317	.406
All	.315	.482	.331	.486	.317	.487

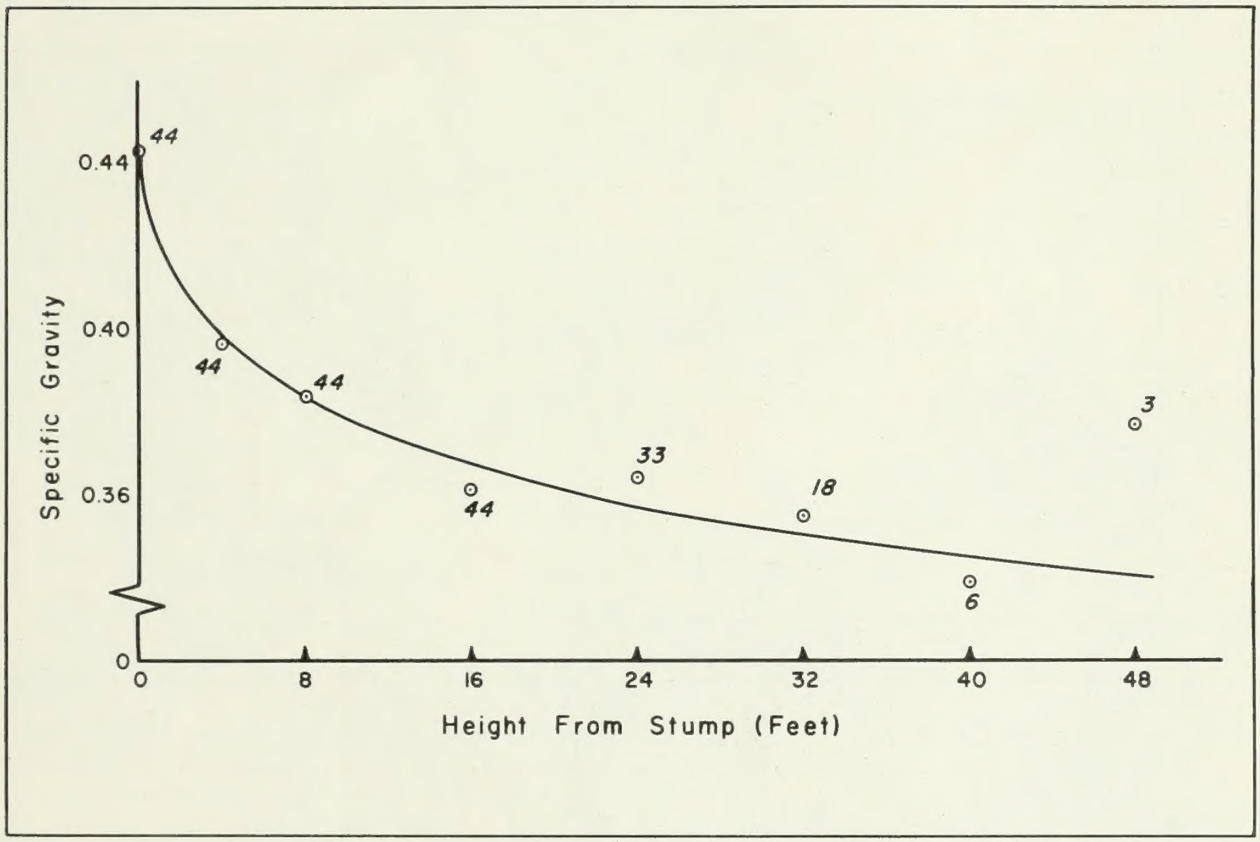

Figure 1.--Specific gravity at successive heights above stump (stem section method).

The relation of tree specific gravity to core specific gravity at breast height was further analyzed for 21 trees of commercial pulpwood size (5.6 inches d.b.h. or larger). Diameters inside bark and outside bark were plotted over height, and the volumes inside bark of the individual sections were obtained using a planimeter.7/ The specific gravity of each section was weighted by its volume to arrive at an average tree specific gravity. The linear relation (fig. 2) is:

7/ U.S. Forest Service Form 558a was used in this procedure.

$$Y = 0.661X + 0.143$$

where
Y = tree specific gravity
X = specific gravity at breast height

The correlation coefficient is 0.754; the standard error of estimate is 0.021.

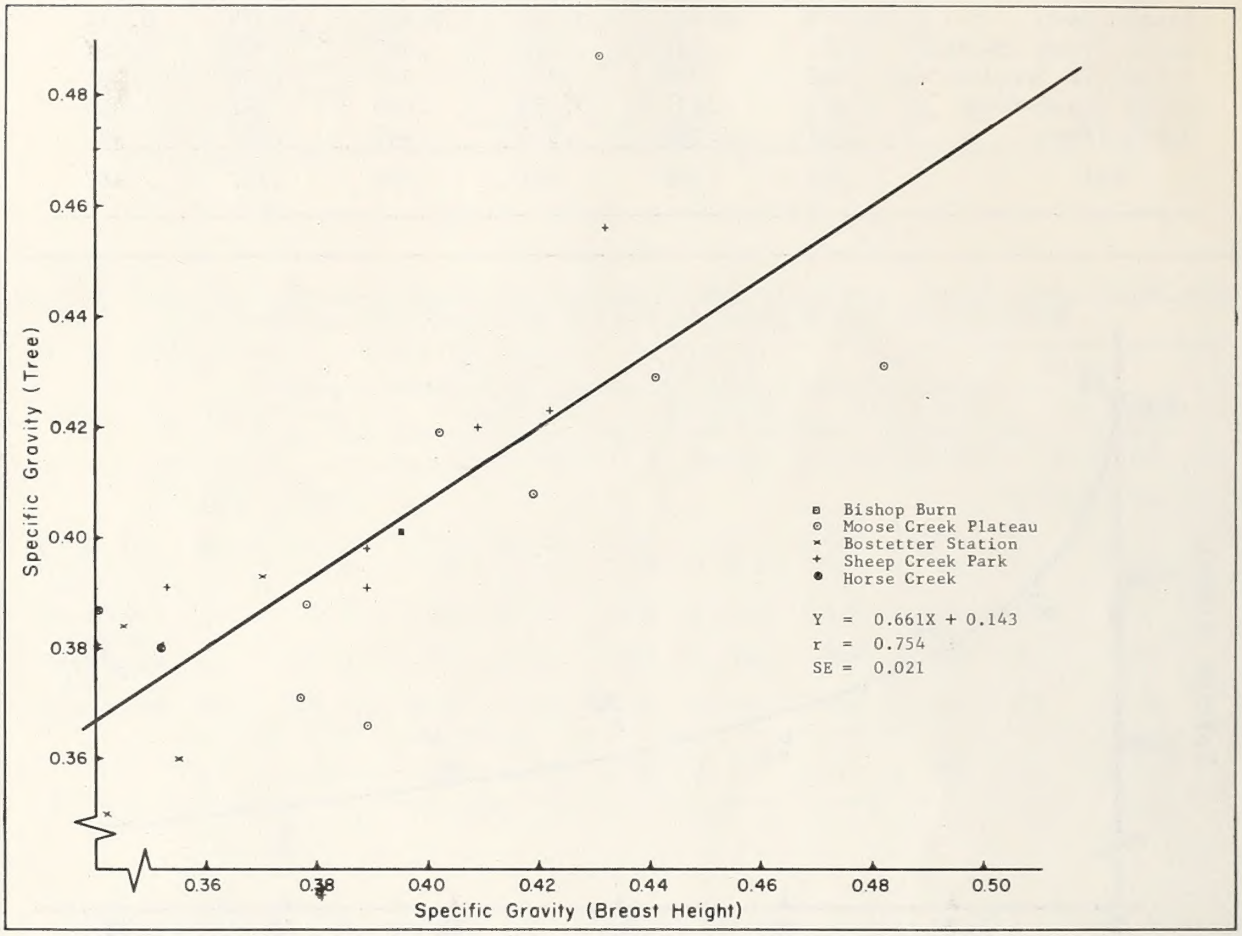

Figure 2.--Relation of mean tree specific gravity calculated by the stem section method to core specific gravity at breast height.

There is a growing need for information on wood quality and weight both by industries that manufacture and use wood products and by public and private agencies responsible for forest production. Wood users are interested in specific gravity because it is related to strength properties. For example, reliable estimates of hardness, static and impact bending, and compression can be derived from specific gravity values. Also, reasonably good estimates of the paintability and gluability of wood can be made. In management planning, conversion of forest inventories and yield estimates from a volume to a weight basis is contingent upon a reasonably accurate method of determining the specific gravity of standing trees.

Because of the basic utility of a knowledge of wood specific gravity and the increasing use of lodgepole pine for lumber, poles, and pulp, future research in this species should include determinations of specific gravity for the entire range of sites, ages, and tree sizes.